

May 23, 2003

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D.C. 20555-0001

10 CFR 50.73

Dear Sir:

**TENNESSEE VALLEY AUTHORITY - BROWNS FERRY NUCLEAR PLANT  
(BFN) - UNITS 2 - DOCKET 50-260- FACILITY OPERATING LICENSE DPR - 52  
-LICENSEE EVENT REPORT (LER) 50-260/2003-003-00**

The enclosed report provides details concerning a manual scram of BFN Unit 2. This report is submitted in accordance with 10CFR 50.73 (a)(2)(i)(A); namely, the completion of any nuclear plant shutdown required by the plant's Technical Specifications. There are no commitments contained in this letter.

Sincerely,

Original signed by

Ashok S. Bhatnagar

cc: See page 2

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Enclosure

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Enclosure

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<b>NRC FORM 365</b> (7-2001)		<b>U.S. NUCLEAR REGULATORY COMMISSION</b>		<b>APPROVED BY OMB NO. 3150-0104</b> <small>Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet e-mail to hjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOS-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.</small>		<b>EXPIRES 7-31-2004</b>			
<b>LICENSEE EVENT REPORT (LER)</b> (See reverse for required number of digits/characters for each block)									
<b>1. FACILITY NAME</b> Browns Ferry Nuclear Plant Unit 2				<b>2. DOCKET NUMBER</b> 05000260		<b>3. PAGE</b> 1 OF 6			
<b>4. TITLE</b> Manual scram of Unit 2 resulting from the 2B reactor recirculation pump trip with OPRM function inoperable.									
<b>5. EVENT DATE</b>			<b>6. LER NUMBER</b>			<b>7. REPORT DATE</b>		<b>8. OTHER FACILITIES INVOLVED</b>	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME
03	26	2003	2003 - 003 - 00			05	23	2003	None
									DOCKET NUMBER
									N/A
<b>9. OPERATING MODE</b>		1		<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.101(h)(2)(ii) and all that apply</b>					
				20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)	
								50.73(a)(2)(ix)(A)	
<b>10. POWER LEVEL</b>		063		20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)	
				20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)	
								73.71(a)(4)	
				20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)	
				20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)	
				20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)	
				20.2203(a)(2)(iv)		x 50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)	
				20.2203(a)(2)(v)		50.73(a)(2)(i)(B)		50.73(a)(2)(vii)	
				20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)	
				20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)	
								OTHER	
								specify in Abstract below or in NRC Form 368A	
<b>12. LICENSEE CONTACT FOR THIS LER</b>									
<b>NAME</b> James E. Wallace, Site Licensing Engineer						<b>TELEPHONE NUMBER (Include Area Code)</b> (256) 729-7874			
<b>13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT</b>									
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
X	AD	DRIV	R305	Y					
<b>14. SUPPLEMENTAL REPORT EXPECTED</b>						<b>15. EXPECTED SUBMISSION DATE</b>		MONTH	DAY
YES (If yes, complete EXPECTED SUBMISSION DATE)						X NO			
<b>ABSTRACT</b> (16)									
<p>On March 26, 2003, at 0018 hours, the 2A reactor recirculation pump tripped as a result of an invalid output ground fault indication in its variable frequency drive (VFD). Operations entered into Technical Specification (TS) LCO 3.4.1 Action A. The reactor power was reduced to approximately 63 percent. At 0244 hours, the 2B reactor recirculation pump also tripped as a result of an invalid output ground fault indication in its VFD. Due to an inoperable Oscillation Power Range Monitor (OPRM) function, TS.3.3.1.1-I was in effect at the time of the event. Abnormal Operating Instruction 2-AOI-68-1B implemented the conditions of TS 3.3.1.1-I, and required Operations personnel to manually scram the reactor when both reactor recirculation pumps tripped.</p> <p>The root cause of this event was spiking in the neutral voltage signals in the VFDs. The cause of the spiking has not been determined. Contributing factors were: lack of a pre-trip alarm, and knowledge about the VFD control function was not available to TVA Engineering personnel. Corrective actions include: (1) The ground fault trip function of the VFDs was changed to an alarm function, (2) Ground fault alarm setpoint was increased, (3) Investigation is ongoing to determine the cause of the voltage signal spiking, (4) Single point failure analysis design standard will be revised to address pre-trip alarms, and (5) Procedural guidance for post-modification testing (PMT) will be revised to address expectations of PMTs.</p>									

## LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
Browns Ferry Nuclear Plant Unit 2	05000260	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	2 OF 6
		2003	-- 003	-- 00	

NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)

## I. PLANT CONDITION(S)

At the time of this event, Unit 2 was at approximately 63 percent power, and Unit 3 was at 100 percent power. Unit 1 was shutdown and defueled.

## II. DESCRIPTION OF EVENT

## A. Event:

On November 22, 2002, the Oscillation Power Range Monitor (OPRM) [IG] was declared inoperable due to a 10 CFR Part 21 issue, namely, a non-conservative value in its algorithm (LER 50-260/2002-003-00). An inoperable OPRM condition is allowed by TS 3.3.1.1.I, by implementing an alternate method to detect and suppress thermal hydraulic instability oscillations. One criterion in Abnormal Operating Instruction 2-AOI-68-1B for the alternate method is to immediately scram the reactor if both reactor recirculation pumps trip while in the RUN mode.

On March 26, 2003, at 0018 hours, the 2A reactor recirculation pump (P) [AD] tripped based on an invalid output ground fault indication in its variable frequency drive (VFD) (DRIV). Operations entered into Technical Specification (TS) LCO 3.4.1 Action A. Unit 2 was reduced to approximately 63 percent power. Reactor recirculation pump 2B was manually decreased in speed to comply with procedural drive flow limitations. At 0244 hours, the 2B VFD also experienced an invalid ground fault indication and tripped the 2B reactor recirculation pump. Therefore, in accordance with plant instruction 2-AOI-68-1B, which implemented the conditions of TS 3.3.1.1-I, Operations personnel manually scrammed the reactor.

As a result of the manual scram, the control rods [AA] inserted as designed. The turbine was manually tripped and reactor pressure was controlled by the turbine bypass valves. Peak reactor pressure experienced was approximately 1003 PSIG, and no safety relief valves operated.

All expected system responses were received, including the actuation of primary containment isolation system (PCIS) [JM] groups 2, 3, 6, and 8 due to an expected temporary lowering of the reactor water level below the actuation setpoint. This PCIS logic isolates shutdown cooling [BO] (if in service), isolates the reactor water cleanup (RWCU) [CE] system, isolates the normal reactor building ventilation [VA], initiates the standby gas treatment (SGT) [BH] system, initiates the control room emergency ventilation (CREV) [VI] system, and retracts Traversing Incore Probes (TIP) [IG] (if inserted). Neither the high pressure coolant injection (HPCI) [BJ] nor reactor core isolation cooling (RCIC) [BN] systems were used during this event.

The VFD vendor concurred with TVA to: (1) increase the ground fault alarm setpoint to 40 percent and (2) re-program the ground fault trip function as alarm only. On March 26, 2003, Unit 2 was restarted, and, at 2230 hours, the reactor established criticality.

This report is submitted in accordance with 10CFR 50.73 (a)(2)(i)(A), the completion of any nuclear plant shutdown required by the plant's Technical Specifications.

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**NARRATIVE** (If more space is required, use additional copies of NRC Form 366A) (17)**B. Inoperable Structures, Components, or Systems that Contributed to the Event:**

The OPRM was declared inoperable due to a 10 CFR Part 21 issue (i.e., a non-conservative value in its algorithm). An inoperable OPRM condition is allowed by TS 3.1.1.I by performing an alternate method to detect and suppress thermal hydraulic instability oscillations. One criterion in 2-AOI-68-1B for the alternate method is to immediately scram the reactor if both reactor recirculation pumps trip while in the RUN mode.

**C. Dates and Approximate Times of Major Occurrences:**

November 22, 2002		OPRM was declared inoperable due to a 10 CFR Part 21 issue
March 26, 2003	0018 hours CST	2A reactor recirculation pump tripped
	0244 hours CST	2B reactor recirculation pump tripped
	0244 hours CST	Unit 2 was manually scrammed
	1539 hours CST	Unit 2 restart began
	2230 hours CST	Unit 2 established criticality

**D. Other Systems or Secondary Functions Affected**

None

**E. Method of Discovery**

The 2B reactor recirculation pump tripped causing the control room to receive numerous indications and alarms.

**F. Operator Actions**

Following the 2B reactor recirculation pump trip while the OPRM function was inoperable, Operations personnel responded by manually scramming the reactor in accordance with an approved instruction and placed the plant in a shutdown condition. All operator actions were appropriate.

**G. Safety System Responses**

All control rods inserted as designed. Additionally, all expected system responses were received, including the actuation of primary containment isolation system groups 2, 3, 6, and 8 due to the low reactor water level condition.

Group 2 - Residual Heat Removal shutdown cooling function isolation (not in service at the time of the event),

Group 3 - Reactor Water Cleanup system isolation

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**NARRATIVE** (If more space is required, use additional copies of NRC Form 366A) (17)

Group 6 - Primary and Secondary Containment isolation, including the normal Reactor Building Ventilation and initiation of SGT and CREV systems

Group 8 - Withdrawal and isolation of the Traversing Incore Probes (probes were not inserted at the time of this event)

No automatic or manual operation of other water make-up systems (such as HPCI, RCIC, RHR, or Core Spray) were required during this event.

**III. CAUSE OF THE EVENT****A. Immediate Cause**

The immediate cause of the event was the tripping of the 2B reactor recirculation pump with the OPRM function inoperable.

**B. Root Cause**

The root cause of this event was spiking in the neutral voltage signals in the VFDs. The cause of the spiking has not been determined.

**C. Contributing Factors**

Contributing factors were: lack of a pre-trip alarm and knowledge about the VFD control function was not available to TVA Engineering personnel.

**IV. ANALYSIS OF THE EVENT**

The reactor recirculation system provides for forced circulation of water through the reactor core. By forcing flow through the core, even flow distribution is achieved in all fuel channels and a higher specific power level can be attained. By controlling the rate of forced circulation through the core, a means is provided for accurate and responsive control of reactor power. The recirculation system is connected to the vessel and make up part of the reactor coolant pressure boundary.

The reactor recirculation system consists of two reactor recirculation pump loops external to the reactor vessel which provide the driving flow of water to the reactor vessel jet pumps. Each external loop contains one high-capacity motor-driven reactor recirculation pump. Each reactor recirculation pump motor is a variable-speed AC, electric motor which drives the pump. The motor is designed to operate continuously at any speed within the power supply frequency range of 11.5 Hz to 57.5 Hz. Variable-frequency drives (VFDs) located outside the drywell supply power to each reactor recirculation pump motor. The reactor recirculation pumps and VFDs perform no safety function.

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The VFDs were installed to replace the existing motor-generator sets during the Unit 2, Cycle 12 outage. Factory acceptance testing, and pre-startup phase of post modification testing had been completed and power ascension testing was in progress. A ground fault trip occurred during pre-startup phase of the post modification testing, and the trip setpoint was increased to address the problem.

When the 2A variable frequency drive (VFD) tripped based on an invalid output ground fault indication, the decreased core flow resulted in Unit 2 power reducing to approximately 63 percent power. The Unit was allowed by TS to operate in the single loop mode with the 2B reactor recirculation pump. However, when the 2B VFD also experienced an invalid ground fault indication and tripped the 2B reactor recirculation pump, the reactor was scrammed.

**V. ASSESSMENT OF SAFETY CONSEQUENCES**

Upon tripping of the 2A reactor recirculation pump, plant operator actions were taken to place the reactor in a stable single-loop operation. When the 2B reactor recirculation pump tripped and knowing that the OPRM function was inoperable, Operations personnel took prompt actions to manually scram the reactor in accordance with an approved plant instruction. The trip of one or two reactor recirculation pumps is an analyzed event, and operation without the reactor recirculation pumps is an analyzed condition. All expected system responses were received, and all systems responded as designed. The water level was maintained well above the top of active fuel, and no emergency makeup water was required. Therefore, TVA concludes that there is no adverse impact on the health and safety of the public as a result of this event.

**VI. CORRECTIVE ACTIONS****A. Immediate Corrective Actions**

The ground fault trip function of the VFDs was changed to an alarm function. Ground fault alarm setpoint was further increased.

**B. Corrective Actions to Prevent Recurrence<sup>(1)</sup>**

Corrective actions include: (1) Investigation is ongoing to determine the cause of the voltage signal spiking, (2) Single point failure analysis design standard will be revised to address pre-trip alarms, and (3) Procedural guidance for post-modification testing will be revised to address expectations of PMTs.

**VII. ADDITIONAL INFORMATION****A. Failed Components**

8000 HP, Water-Cooled, Robicon Perfect Harmony VFD

(1) TVA does not consider these corrective actions as regulatory commitments. The completion of these actions will be tracked in TVA's Corrective Action Program.



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**NARRATIVE** (If more space is required, use additional copies of NRC Form 366A) (17)**B. Previous LERs on Similar Events**

Even though there have been other reactor recirculation pump trips which resulted in a plant scram, these events differ in that the VFDs were newly installed during the Unit 2, Cycle 12 refueling outage. Therefore, any previous corrective actions for reactor recirculation pump trips would not have precluded this event.

**C. Additional Information**

None

**D. Safety System Functional Failure Consideration:**

This event does not involve a safety system functional failure which would be reported in accordance with NEI 99-02. During the scram, all safety-related equipment performed in accordance with its design function.

**E. Loss of Normal Heat Removal Considerations:**

The main condenser was retained as the heat sink during this event, and the feedwater system continued to provide reactor vessel water inventory make-up. No automatic or manual operation of HPCI or RCIC occurred during this event. No safety relief valves operated. The suppression pool was not used as a heat sink. Therefore, this event does not constitute a scram with a loss of normal heat removal which would be reportable in accordance with NEI 99-02.

**VIII. COMMITMENTS**

None